Integration of Airport Surface Communication Systems

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Outline of Presentation

- **Introduction**

- Methodology

- A Communication Reference Model

- Future Research Efforts

- Summary

Introduction

- **Airport Surface Congestion**
  - A key traffic capacity problem NAS

- **Information about Surface Movement**
  - Maintained through controller observation
  - VHF voice communications

- **Flight Planning & Scheduling, Gate Management, Control, and Servicing of Aircraft**
  - Lack of easily accessible, *integrated* planning information
  - Results in inefficiencies

Introduction (cont.)

- Dedicated & Separate Comm Systems Architectures
  - No system-wide interoperability and information sharing
- Stakeholders Build Own Comm Infrastructures
  - Self-independent
  - Lack the flexibility for needed data exchange with others
- Analog VHF Communication Systems
  - Only for voice
  - Inability to transmit operational data or to dynamically establish groups of users
  - Lack of necessary real-time collaborations among stakeholders for special events where information sharing is paramount

Introduction (cont.)

- **What Do We Want?**
  - Fully integrated communication services to all stakeholders at airport surfaces
    - To improve the airport surface operations by dynamic planning of surface movement
    - To maximize airport throughput
  - A common communication infrastructure
    - For all the stakeholders
    - While meeting stakeholders' individual needs
  - A scalable, flexible, & secure comm. infrastructure
   - Meet current and future needs

Introduction (cont.)

- A Common Comm Infrastructure Has
  - A complete set of requirements
    - Different stakeholders for airport surface operations
    - Collected via system engineering methodology
  - A communication reference model
    - Meet current and future requirements
    - Functional entities, interfaces between entities, etc.
    - Technologies applicable to the model

Methodology for Collecting Requirements

- **Many System Engineering Tools Available**
  - For analyzing stakeholders' requirements
- **Simplified Version to Discuss Proposed Methodology**
  - Purpose is to capture all requirements from stakeholders
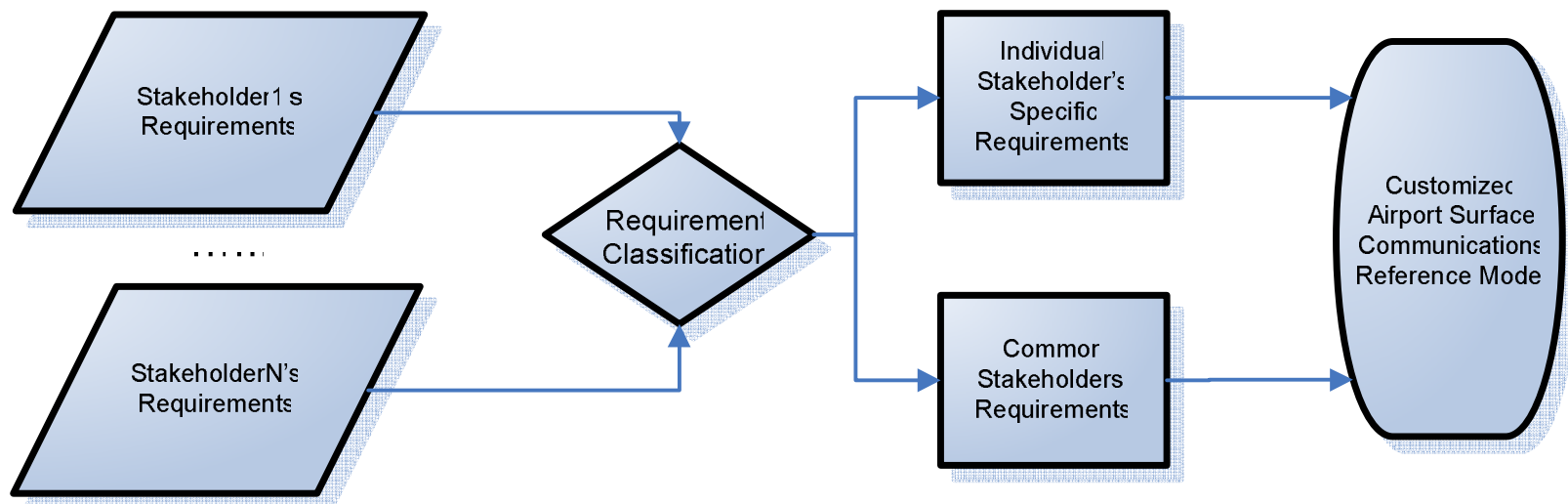
Methodology (cont.)

- Requirements From Each Stakeholder
  - Can be classified into two major categories:
  - Common requirements
    - communication systems features common to all airport surface stakeholders
  - Specific requirements
    - specific, non-common needs for each individual stakeholder
- Based on the two major categories:
  - identify and characterize stakeholder needs
  - customize the communication reference model
- Another set of requirements
  - shared by some, but not all stakeholders
  - derive from the two categories of requirements

Current Communication Systems

- Airport Surface Communication Systems Consist of Various Disparate Networks
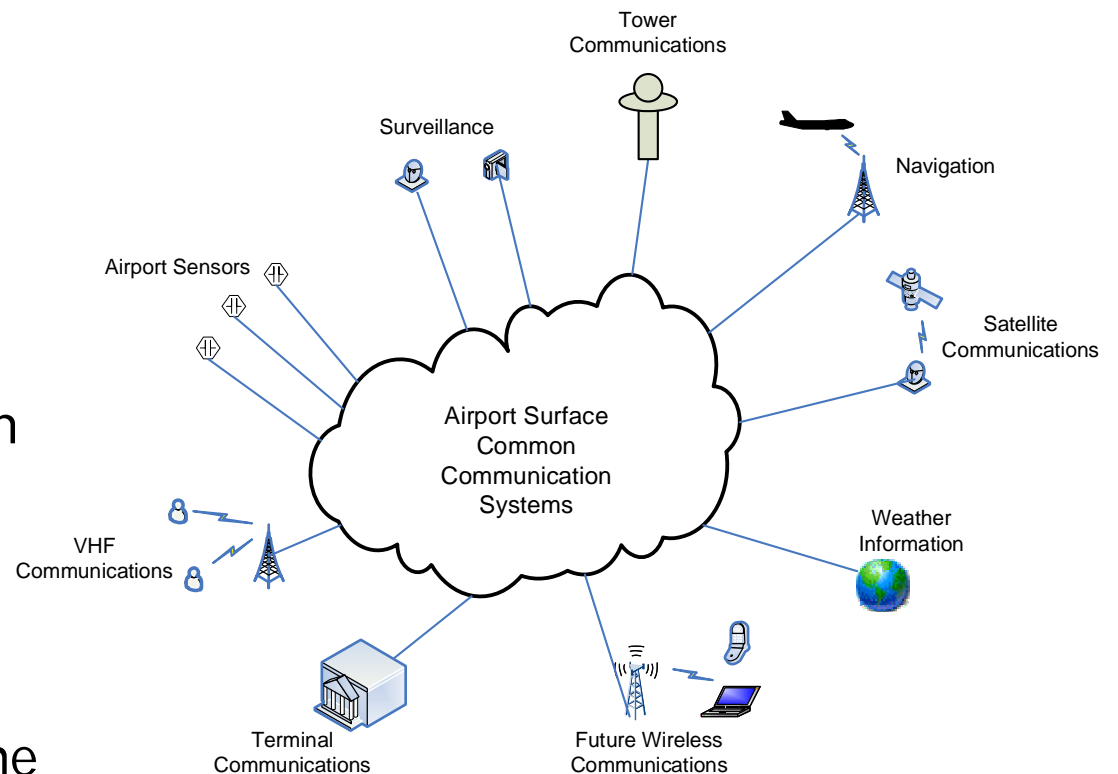
    - VHS Communications Network
    - Navigation Network
    - Surveillance Network
    - Sensor Network
    - Tower Communications Network
    - Weather Information Network
    - Satellite Network
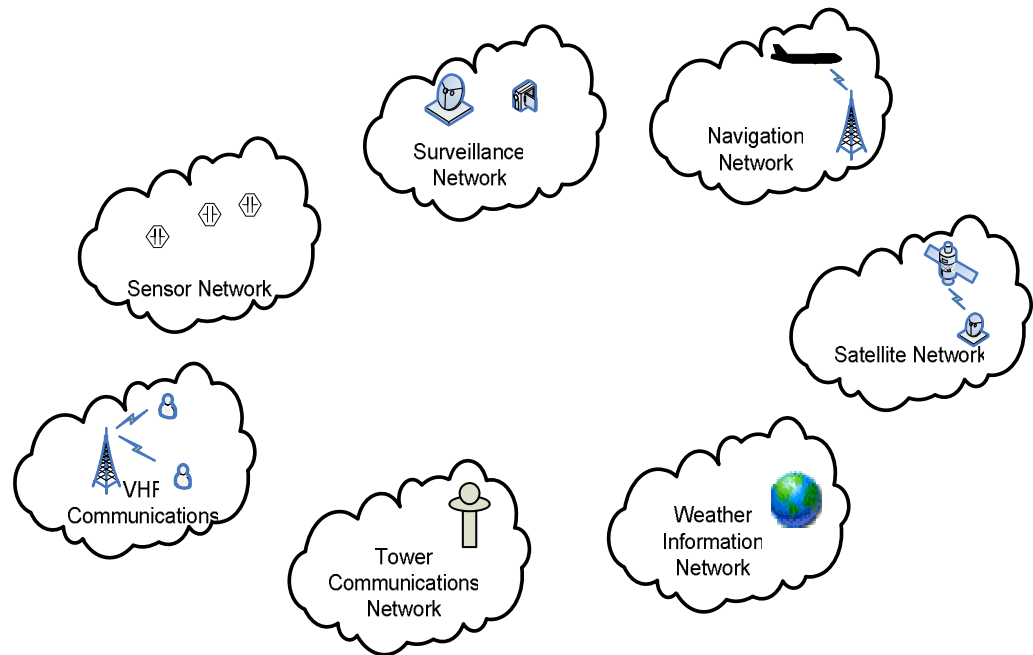
Integrating Disparate Networks

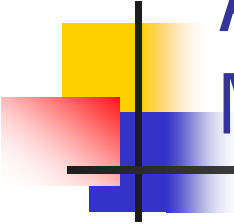- **The Disparate Networks Can Be Integrated**

  - use the advanced IP networking technologies
  - use the same communications infrastructure for all stakeholders
  - distribute the information data through the same communications infrastructure
  - provide the logical separation of traffic to the appropriate destinations

Tower Communications

Surveillance

Navigation

Airport Sensors

Satellite Communications

Airport Surface Common Communication Systems

Weather Information

VHF Communications

Terminal Communications

Future Wireless Communications

A Communication Reference Model

- Propose a Communication Reference Model
  - To consolidate the networks into one
- Reference Model Consists of Four Components
  - End Devices, Access Networks
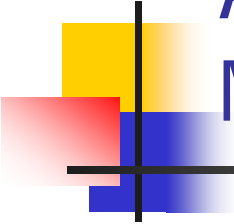 - Intelligent Core Network, External Interfaces
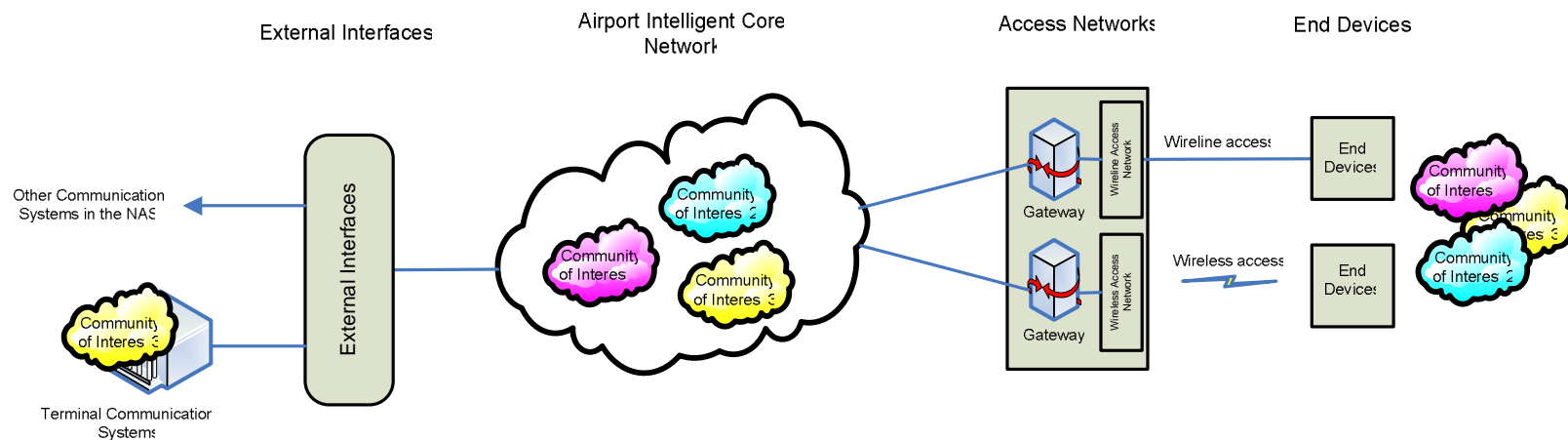
A Communication Reference Model (cont.)

- **End Devices**
  - A wide range of end devices, such as surveillance radar, ground and gate service crew's voice and data communications devices, etc.
- **Access Networks**
  - Include wireless (radio) access networks and wired access networks
  - Is Ubiquitous
  - Provide the mechanics for end devices to access the Intelligent Core Network
- **Intelligent Core Network**
  - Provide intelligent switching functions
  - Provide necessary services such as the creation of Community of Interest groups
- **External Interfaces**
  - Provides the ability to connect with other communication systems in the NAS. e.g. seamlessly integrated with Terminal Communications

A Communication Reference Model (cont.)

- **Benefits**
  - Provide a unique way to integrate disparate networks into one, for airport surface operation communications
  - Allocate mission critical and non-critical voice, data, and video requirements to different design components
  - Leverage the ubiquitous access methods to support multiple mission critical and non-critical voice, data, and video for various stakeholders
  - Provide a framework to create and maintain various levels of communications based on Communities of Interest among stakeholders
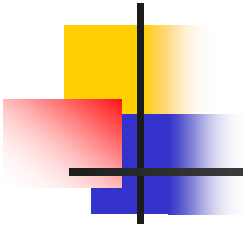 - Provide the flexibility to seamlessly migrate to the new technologies

Future Research Efforts

- **A Functional Framework**
  - Examine functional entities required by the airport surface communications systems
  - Define the potential interfaces among these entities.

- **Interoperability among Different Physical Communication Technologies**
  - Wireless (VHF, CDMA, etc.)
  - Satellite network (GPS, etc.).

- **Impacts of IPv6 & Other Emerging Technologies**
  - on the systems

Summary

- ## Propose Integrating Disparate Networks Into One
  - For airport surface operation communications
- ## A Requirement Analysis Methodology
  - Capture all stakeholder requirements
  - Understand specific airport surface operation communications needs for each stakeholder
- ## A Viable Comm Architecture & Services Solution
  - A communication reference model as an initial step
- ## Further Studies Are Needed
  - To develop a functional architecture framework
  - To address potential issues associated with the architecture

Q&A